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## Pulmonary Paragonimiasis in Southeast Asians Living in the Central San Joaquin Valley

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HUMAN PARAGONIMIASIS is caused by the lung fluke *Paragonimus westermani* and other species. This parasite is endemic in the Far East, especially in areas of central China, Japan, Korea, the Philippines, and Southeast Asia (Vietnam, Laos, Cambodia, Thailand).<sup>1</sup> The disease is also found in Central and South America, West Africa, and the Indian subcontinent. Its occurrence in the United States is rare.

The central portion of California's San Joaquin Valley has had a large influx of refugees from Southeast Asia. As of 1988, an estimated 48,000 persons had emigrated to the counties of Merced, Madera, Fresno, Kings, and Tulare (*Estimates of Refugees in California Counties and the State: 1988, Report SR 88-1* [January 1990], Department of Social Services, County of Fresno, California, pp 8-9). This population is now thought to exceed 60,000, of which about 49,000 are living in the Fresno County area (*Fresno County Plan for Refugee Services—1990*, Department of Social Services, County of Fresno, California, p 5). Heretofore, no cases of paragonimiasis from the Central Valley have been reported to the state health department (Terry Thompson and Edward Graham, PhD, MPH, Department of Health Services, State of California, oral communication, December 1990). Therefore, we report the following four cases documented within this population. In addition, we review the life cycle and human pathogenesis of this parasite.

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## Report of Cases

### Patient 1

The patient, a 39-year-old Laotian man, presented to a local hospital in Merced, California, in January 1979 because of persistent hemoptysis. When he was a fighter pilot in 1968, he was shot in the chest, resulting in hemoptysis. After chest tube placement, he did well except for infrequent episodes of hemoptysis over an 11-year period, for which he received penicillin shots. He became a United States resident in 1977.

On physical examination, the patient had scars from the gunshot wound at the right upper anterior chest and the chest tube site on the back. He had a leukocyte count of  $11 \times 10^9$  per liter (11,000 per  $\mu$ l) with 0.06 eosinophils. A recent purified protein-derivative (PPD) skin test measured 14 mm. Chest x-ray films showed minimal fibrosis in the right upper lobe, attributed to the old gunshot wound, and shifting cystic opacifications in both upper lobes. Several sputum specimens were negative for acid-fast bacilli.

Based on the significant PPD reaction, a regimen of isoniazid, 300 mg a day, was started. After three months of isoniazid therapy, the patient stopped the medication on his own because of side effects. He continued to have hemoptysis. Bronchoscopy was unrevealing. Serologic tests for coccidioidomycosis were negative. A sputum test for ova and parasites was positive for *Paragonimus* species. A complement fixation titer for *P westermani* was positive at 1:128. The patient was given bithionol, 30 mg per kg of body weight every other day for three to four weeks. He reportedly took some of the medication as prescribed, and the hemoptysis had ceased when he was seen several months later. The patient has since been lost to follow-up.

### Patient 2

The patient, a 13-year-old Laotian boy, was seen at a local community hospital in February 1984 because for the past three days he had had fever, chills, and hemoptysis. He had been in the United States for two years. While living in Laos, he had had bouts of hemoptysis since age 7. After drinking a home remedy, he purportedly stopped coughing blood within three days. Years later, his hemoptysis recurred while he was in Thailand. He reports being treated with some antituberculous medication for several months. He remained in good health until his current illness.

On physical examination, coarse rhonchi were heard over the right anterior portions of his chest. The patient's leukocyte count was  $6.1 \times 10^9$  per liter (6,100 per  $\mu$ l) with 0.05 eosinophils. Other laboratory values were within normal limits. A chest radiograph revealed a few cystic areas in the right lower, right upper, and left upper lobes. A presumptive diagnosis of pulmonary tuberculosis was made, and the patient was sent to the Fresno County Public Health Department for further workup. Skin tests for PPD and coccidioidomycosis were negative. Culture of several sputum specimens for acid-fast bacilli and fungi was negative. A sputum test for ova revealed *P westermani*.

The patient was treated with praziquantel, 25 mg per kg three times a day for one day. He was seen three weeks later with the report that his hemoptysis had resolved. Tests of sputum were negative for ova. A second chest radiograph showed no substantial change. He has remained well in follow-up to the present.

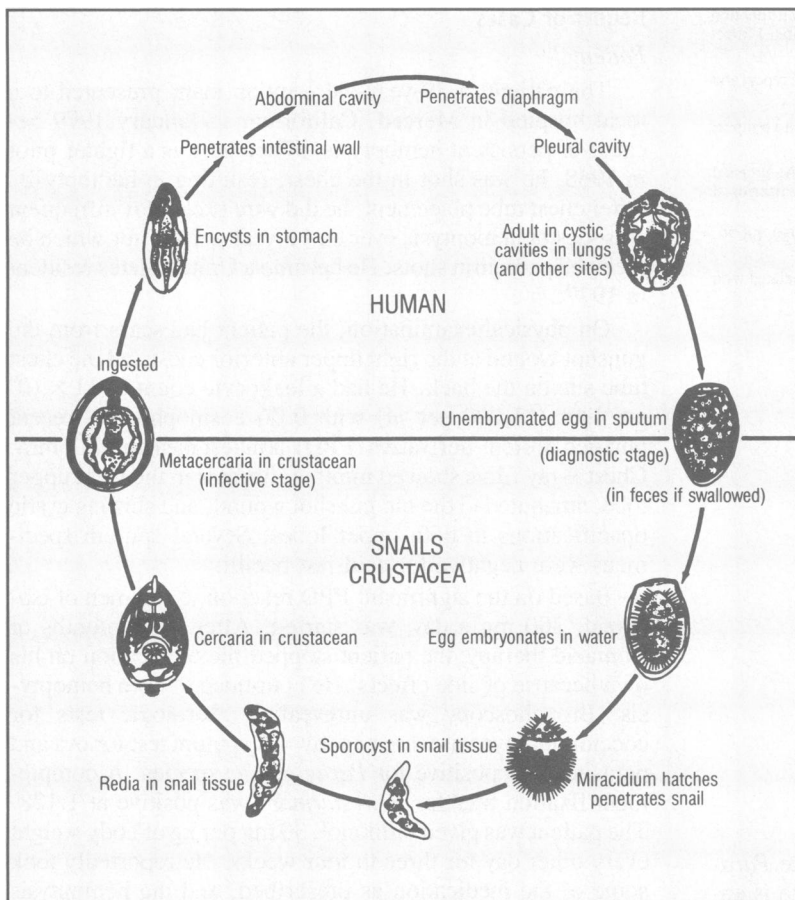


Figure 1.—The life cycle of the trematode *Paragonimus westermani* is shown (from the Centers for Disease Control, Atlanta, Georgia).

### Patient 3

The patient, a 20-year-old Laotian man, was seen at a local public health clinic in September 1988 because of hemoptysis, having emigrated to the United States a year before his presentation. A physical examination revealed scattered inspiratory crackles at the right base of his chest. A chest radiograph showed an infiltrate in the right middle lobe. A PPD skin test measured 10 mm. Several sputum smears and cultures for acid-fast bacilli were negative. A diagnosis of active tuberculosis was made, and he was treated with a regimen of isoniazid, rifampin, and pyrazinamide.

In December 1988, the patient was seen at the neurology clinic at Valley Medical Center in Fresno complaining of vertigo. There was a questionable history of seizures over the past four to five years, but an extensive neurologic workup was negative. His antituberculous regimen was stopped after five months because of the vertigo. He returned to the medicine clinic at Valley Medical Center in April 1989. His dizziness had resolved; his episodes of hemoptysis persisted. Serial chest radiographs showed no changes; the right middle lobe infiltrate was considered to be a chronic interstitial process. On testing both sputum and stool specimens for ova and parasites, the sputum was found to harbor *P. westermani*. The patient was given praziquantel, 25 mg per kg three times a day for one day. He tolerated the medication well and returned four weeks later having no more hemoptysis. Retesting the sputum for ova and parasites was negative.

### Patient 4

A 40-year-old Thai woman was seen at the Merced County Health Department in February 1991 for refugee

screening within a month after she arrived in the United States. She had had intermittent hemoptysis for the past four years. In Thailand her symptoms were attributed to tuberculosis. She was treated with isoniazid, rifampin, ethambutol hydrochloride, and pyrazinamide. The pyrazinamide was given for two months, and the other medicines were continued for a year. Despite her compliance in treatment, intermittent hemoptysis continued.

On physical examination, the patient had scars from an old bullet wound entering the posterior right side of her chest, with multiple exit sites under her right breast. The chest was clear to auscultation. A chest radiograph showed infiltrates bilaterally in the middle and lower lung fields. A density in the left lower lung field appeared to have a central air-fluid level. A PPD skin test was negative. Two sputum smears for acid-fast bacilli were negative. Paragonimiasis was suspected on the basis of a nonsignificant PPD test, continued hemoptysis, and persistent abnormal x-ray findings despite an adequate course of supervised antituberculous treatment. A sputum test for ova and parasites revealed *P. westermani*. The patient was given praziquantel, 25 mg per kg three times a day for two days. At follow-up visits over the next two months, the hemoptysis had stopped. The infiltrates and possible cavitory lesion had cleared.

### Discussion

A history of shellfish or raw crab ingestion was later confirmed in the first three patients. The fourth patient gave a history of making salads with watercress taken from the local rivers in Southeast Asia. Each patient had been treated for tuberculosis without resolving either their hemoptysis or

their pulmonary infiltrates. In none of these patients were sputum studies positive for tuberculosis. The diagnosis was confirmed by examining the sputum for *P. westermani* ova.

The life cycle of the organism and its pathogenesis within the human host are well described (Figure 1).<sup>2-6</sup> A reservoir of this trematode exists in many wild animal hosts. The adult worms are 0.8 to 1.6 cm long, 0.4 to 0.8 cm wide, and 0.2 to 0.5 cm thick. Their ova are produced in the lung tissue of a mammalian host and are expelled by coughing. Miracidia are released from the ova in water. Snails serve as the initial intermediate hosts for the miracidia, which mature into cercariae. The cercariae, released in the water, then invade crabs, crayfish, and other crustacean hosts. Cercariae become encysted metacercariae that may be released from dead or injured crustaceans into the freshwater environment.

Human infection depends on the ingestion of uncooked or pickled crayfish, crabs, or other hosts that harbor the metacercariae. Metacercariae can be accidentally transferred to the mouth during the preparation of shellfish, even if properly cooked. Drinking water and eating vegetation from infested rivers or ponds have been implicated in causing infection. In humans, metacercariae hatch in the wall of the small intestine. The young flukes penetrate into the peritoneal cavity and migrate through the diaphragm and pleura into the lung. There they encyst as adult worms. The lung tissue surrounding encystment exhibits transient patchy densities. Cysts adjacent to a bronchus often rupture through the mucosa, discharging eggs into the sputum. These discharges cause coughing and hemoptysis. Heavy infestations may encyst in many other parts of the body.

Although most infections are asymptomatic, recurrent hemoptysis is the cardinal symptom of pulmonary paragonimiasis. Eosinophilia may be present. Chest radiographic findings generally mimic those of tuberculosis and are often nondiagnostic. The diagnosis is made by finding eggs in the sputum. Eggs swallowed from infected sputum may be found in stool. Western blot testing for *P. westermani* is available from the Centers for Disease Control, Atlanta, Georgia. This test is considered more sensitive and specific than the complement fixation test (J. Fried and M. Wilson, MS, Centers for Disease Control, oral communication, October 1991). Serologic testing requires clinical correlation and thus is not a substitute for sputum confirmation. Serial sputum studies may be required to monitor patients receiving treatment for the parasite.

Regarding the cases described, certain observations deserve comment. Stool specimens of one patient did not contain ova and parasites. Ova may be found in some patients who presumably swallow their infested sputum. Testing the stool for ova and parasites has a low yield; neither is the sputum always positive. In those cases, a serologic test may be of help. A positive serologic test confirms exposure to the parasite but gives no information on where the infection resides. A positive sputum test, however, is completely specific for the presence of pulmonary paragonimiasis. He-

moptysis was the major complaint in each patient. We know of no studies that examine the incidence of paragonimiasis in patients with hemoptysis (in contrast to tuberculosis, for example). This question deserves further investigation.

The possibility that paragonimiasis is underdiagnosed in the central San Joaquin Valley is difficult to extrapolate. We know of no reliable figures as to the prevalence of paragonimiasis in the Southeast Asian countries of Cambodia, Laos, and Vietnam. In Thailand, the prevalence in humans has been as high as 3.6%.<sup>7</sup> China has reported prevalence estimates ranging from 15% to 45% in the southern provinces.<sup>8</sup> At present, *P. westermani* is not known to be transmitted within the United States.

Praziquantel has superseded bithionol as the treatment of choice for pulmonary paragonimiasis because of its safety, high level of efficacy, and ease of use. It is noteworthy that all of these patients were in good health after physicians had proceeded with the appropriate treatment. When praziquantel was first released in the US during the 1980s, single-day therapy was considered appropriate for cure.<sup>9</sup> Because the disease persisted in some patients treated with single-day therapy, praziquantel, 25 mg per kg three times a day for two days, is now recommended.<sup>10,11</sup>

## Summary

We describe four cases of pulmonary paragonimiasis in Southeast Asians who emigrated to the central San Joaquin Valley of California. Physicians should be alerted to the possibility of this disease in Asian patients with hemoptysis and pulmonary infiltrates. Paragonimiasis can masquerade as pulmonary tuberculosis, especially in patients from areas that are endemic for both the parasite and the tubercle bacillus. The ease and safety with which this infection can be treated, in contrast to tuberculosis, reiterates the importance of diagnosing this lung fluke when it is present.

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